PATENT SPECIFICATION

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434,330

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COMPLETE SPECIFICATION

Improvements in and relating to the Connection of the Frame with the Axles of Vehicles

We, DAIMLER-BENZ AKTIENGESELLSCHAFT, of Stuttgart-Untertürkheim, Germany, a German company, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a connection of the frame with the axles or axle units of vehicles, more particularly motor vehicles with four independently guided wheels, and has for its main object to provide a manner of supporting the frame on these axles, which is as free as possible from twisting stresses, the arrangement being such that springing motions of the wheels cause no twisting stresses or only greatly reduced twisting stresses to act on the frame. In the case of independently guided or independently sprung wheels this is of special importance, as the twisting forces normally have a far greater effect on the frame with such arrangements than with the usual rigid axles.

For this purpose, according to the invention, one of the axles, more particularly the front axle, is connected in such a manner with the frame, for instance by a link connection, that the frame can swing relatively to the axle about a substantially central longitudinal axis, while the other axle, for instance the back axle, is formed by two independently swinging half axles sprung with respect to the frame, which are specially suitable for producing stability of the vehicle body for preventing the lateral inclinations due for instance to centrifugal force when negotiating curves.

According to a further feature of the invention the wheels are mounted independently of the frame or independently of one another on an axle piece and are sprung with respect to the latter or to one another, the axle piece being so connected to the frame, for instance in a pivotal manner, that the frame can swing with respect to the axle piece about a longitudinal axis of the vehicle. Through suitable springing of the axle piece with respect to the frame a soft springing (on a wheel rising when an obstacle is encountered) and at the same time greater stability when negotiating curves can be obtained.

Preferably the frame is connected to the axle piece by a pivot which is placed as high as possible, so that the lateral inclination of the vehicle body under the influence of centrifugal force shall be as slight as possible.

Constructional examples of the invention are illustrated in the accompanying drawings.

Fig. 1 shows a perspective view of a vehicle frame according to the invention with a freely swinging front axle and a stabilising back axle, the front wheels being guided and sprung independently of the frame.

Fig. 2 is an elevation of a front axle with independently guided wheels, the frame being capable of swinging laterally independently of the springing of the wheels, but being dependent on the guiding of the wheels.

Fig. 3 is an elevation of a back axle with swinging half axles pivotally mounted laterally of the longitudinal central axis of the vehicle.

Fig. 4 is an elevation of a further front axle construction according to the invention with damping arrangements between frame and axle.

Figs. 5 and 6 show two further examples of axle arrangement according to the invention and

Fig. 7 is a section on the line A—B of Fig. 6.

In Fig. 1 a is the frame, b are the front wheels and c the rear wheels. The wheel carriers or steering swivels b_1 of the front wheels are connected each by two link members d_1, d_2 with the axle piece e in such a manner that they are guided parallel to one another. Each upper link member is sprung by means of a helical spring f against a bracket e_1 fixed to the axle piece e. In addition the axle piece e is provided at its centre with an upwardly directed forked bearing member e_2, on which the frame a is suspended by means of a pin g. The two longitudinal frame members are for this purpose provided with an upwardly cranked trans-

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verse member a_1, so that the axis of rotation of the frame, determined by the pin g, lies above the longitudinal frame members.

At the rear axle the differential gear h is fixed rigidly or elastically to a further transverse member a_2. The rear wheels are mounted on swinging half axles i_1, i_2, which swing for instance together with the wheels about a central longitudinal axis of the vehicle. Each half axle is sprung by a for instance unguided helical spring k_1, k_2 with respect to the frame directly against the longitudinal frame members.

As will be seen, the frame is suspended only in three points on the axles, viz. once in the point O at the front axle by means of the pin g and twice at the rear axle in the point K_1 and K_2 by means of the helical springs k_1 and k_2. The frame is thus supported so as to be free from twisting stresses, as it only follows the motions of the rear wheels, but is unaffected by the motions of the independently moving front wheels. The axis of inclination of the vehicle body extends from O to P, P being the point of intersection of the swinging half axles i_1 and i_2 with the central longitudinal plane of the vehicle. Preferably the axes of the pin g and of the pivots of the swinging half axles coincide with this straight line O—P. As this straight line extends close past the centre of gravity S of the vehicle body, the centrifugal force acting in the centre of gravity S can cause only a slight lateral inclination of the vehicle body.

A suspension of the vehicle body which is independent of the springing of the front wheels is also provided in the arrangement according to Fig. 2. In this case the front wheels are guided by a link member l and a leaf spring m. The latter is pivotally supported at m_1 on the frame or on the vehicle below a. The link members l are also pivoted to the vehicle body. This arrangement provides not only a springing of the wheels, which is independent of the suspension of the vehicle body, but in addition the wheels are positively displaced by the link members, on transverse oscillations of the vehicle body occurring.

The rear axle may in conjunction with the construction shown in Figs. 1 or 2 be constructed as shown in Fig. 3. In this case the swinging half axles i_1 and i_2 are supported laterally of the differential casing h in pins n_1 and n_2. The axis of the transverse oscillations lies in this case about at P_1, that is approximately in the point of intersection of the two straight lines laid through the points of contact of the wheels with the road surface on the one hand and the pivots of the swinging half axles on the other hand. The further the pivots n_1 and n_2 move apart, the more stable will the vehicle therefore be with respect to transverse oscillations.

In Fig. 4 the frame a is suspended by a ball and socket joint g_1 on the bearing support e_2 of the front axle e. Furthermore between the axle and the frame cylindrical rubber buffers p for instance are provided, which are each on the one hand clamped between two stops q_1 and q_2 fixed to the axle by means of a pin r and on the other hand are supported in the bore of a bracket s fixed to the frame. Preferably the rubber buffer is vulcanised on its circumferential surface to the bearing bracket s. The rubber buffers are furthermore so arranged that their central axis or that of the pin r extends tangentially to the radii drawn from the ball and socket joint g_1. On the frame swinging about the ball and socket joint g_1 the rubber buffers will thus be stressed in the longitudinal direction. At the same time the rubber buffers also take up elastically those forces which seek to turn the axle relatively to the frame about an axis running vertically through the ball and socket joint g_1. By this means on the one hand the shocks acting in the direction of travel are damped and on the other hand a greater freedom of the steering wheels from wobble is effected. Through a suitable dimensioning of the rubber buffers it is in every case possible to adapt the damping or springing between the axle and the frame to the particular conditions. In certain circumstances simple elastic stops between the frame and the axle will suffice, for instance rubber buffers disposed below the longitudinal frame members according to Fig. 1 and fixed to the frame or to the axle, by which the relative swinging of the two parts with respect to one another is limited.

The springing of the wheels, which is in this case effected for instance in each case by means of the helical springs f_1 disposed between the two link members d_1 and d_2, is again independent of the frame, that is to say, the wheels can swing upwards without positively loading the frame. The spring forces are on the contrary first taken up by the axle and equalised. Only a portion of the springing forces will be transmitted to the frame, according to the yielding capacity of the rubber buffers or according to the inclined position adopted by the axle e. At the same time the inclined position of the axle causes a portion of the energy of the shock acting for instance on one wheel to be transmitted to the spring of the oppositely disposed wheel and to be

absorbed there. The spring will therefore be relatively soft.

In the constructional form shown in Fig. 5 springs, for instance unguided helical springs t are interposed between the frame a and the axle e which is in this case again pivotally attached to the latter at g, while the springing of the wheels is effected for instance in each case by a helical spring f_2 which is disposed in the interior of the tubular axle and is actuated by an arm of the lower link member d_2. When it is required for the frame to be supported in a manner which is as free as possible from twisting stresses, particularly soft springs t must be provided. For a particularly stable connection between the axle and the frame, on the other hand, relatively hard springs t are of advantage, which may for instance be relatively harder than the springs f_2.

Another constructional form is shown diagrammatically in Figs. 6 and 7. In this case the wheels b are guided by means of the piston-like link members b_2 in cylinders e_1 of the axle e and are sprung in these cylinders by springs f_3. The whole of the axle is in this case again suspended by means of a ball and socket joint g on the transverse member a_1 of the frame. On either side of the central longitudinal plane of the vehicle the axle is clamped between two rubber buffers u_1, u_2 which are disposed above the longitudinal frame members and which partially embrace the axle from front and back and thereby more or less strongly brake or elastically absorb the oscillating motions between the frame and the axle.

The constructional examples might be further multiplied to any extent. Thus for instance it is not necessary to provide a joint as such between the axle and the frame; the relative swinging motion of the two parts might also be effected in another way, for instance by means of rolling curves, the arrangement being for instance such that the frame rolls by means of a rolling member on a rolling surface of the axle, having for instance the form of the arc of a circle, such, that its centre of oscillation lies as high as possible. Furthermore, in each case any suitable members, for instance leaf springs, helical springs, rubber springing, hydraulic springing and so on, might be provided on the one hand for the springing of the wheels with respect to the axle and on the other hand for supporting the frame with respect to the axle. Instead of the front wheels being guided by means of link members or cylindrical guides, leaf springs, swinging half axles, levers swinging in longitudinal planes or the like might be used. The various elements shown in the Figures might also be interchanged. For instance, in all cases the frame can be suspended with respect to the axle without springing or damping or in all cases with springing or damping so as to be capable of oscillating. The invention also extends to the arrangement and the individual features of the axle constructions per se. independently of the suspension of the frame on the other axle. The axle arrangements may be used in the same way for rear axles as for front axles.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Suspension means for connecting the wheels to the frames of vehicles, more particularly for power driven vehicles having four independently guided wheels, comprising an axle, more particularly the front axle, on which the wheels are suspended and which is connected to the frame, preferably by means of an articular joint, in such a manner as to be capable of swinging around a substantially central longitudinal axis of the vehicle, in combination with swinging half axles for the other wheels, more particularly the rear wheels, the said half axles, together with the wheels thereon, swinging independently of one another around longitudinal axes of the vehicle.

2. Suspension means for connecting the wheels to the frames of vehicles, more particularly for power driven vehicles, having four independently guided wheels, characterised by the combination of suspension means for the front wheels such that the wheels are guided parallel to and independently of one another and are connected to the frame in such a manner that the frame can swing relatively to the wheels around a longitudinal axis situated at least substantially at the height of the wheel centres for lateral inclinations of the vehicle body, with swinging half axles for the rear wheels such that the half axles, together with the wheels thereon can swing independently of one another around longitudinal axes of the vehicle.

3. Suspension means for connecting the wheels to the frames of vehicles as claimed in claim 1 or 2, characterised by the feature that the rear half axles which are sprung with respect to the frame (for instance by means of helical springs bearing directly against the longitudinal frame members) are pivotally attached outside the central longitudinal plane of the vehicle to the frame or the casing of the differential gear or the like.

4. Suspension means for connecting

the wheels to the frames of vehicles as claimed in claim 1, 2 or 3, characterised by the feature that the wheels of the axle which is connected to the frame in such a manner as to be capable of swinging around a substantially central longitudinal axis are suspended on this axle, or on an axle piece in lieu of this axle, independently of one another, preferably by means of link parallelograms, and guided more particularly parallel to or substantially parallel to one another.

5. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims, characterised by the feature that the wheels of the axle which is connected to the frame in such a manner as to be capable of swinging are sprung with respect to this axle, or with respect to the axle piece in lieu of this axle, while the swinging half axles of the other wheels, together with the wheels, are sprung directly with respect to the frame.

6. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims, characterised by the feature that the pivotal connection between the frame and the axle piece is made such that the axis of oscillation for the lateral swinging motions of the frame with respect to the axle piece lies above the wheel centres, more particularly approximately at the same height as or above the centre of gravity of the vehicle body.

7. Suspension means for connecting the wheels to the frames of vehicles, more particularly as claimed in any of the preceding claims, and having an axle piece which is connected to the frame in such a manner as to be capable of swinging around a substantially central longitudinal axis, preferably by means of an articular joint, on which axle piece the wheels are resiliently suspended, characterised by the feature that, in addition to the springing of the wheels with respect to the axle piece, further springing or damping means are provided between the axle piece and the frame.

8. Suspension means for connecting the wheels to the frames of vehicles, more particularly as claimed in any of the preceding claims, and having an axle piece which is connected to the frame in such a manner as to be capable of swinging around a substantially central longitudinal axis, preferably by means of an articular joint, on which axle piece the wheels are suspended, preferably independently of one another, characterised by the feature that the connection of the axle piece to the frame, preferably by means of a ball joint, is such that, in addition to the swinging movement around a longitudinal axis, the axle is capable of yielding to a limited extent in the horizontal direction against the action of resilient abutment means, preferably rubber buffers.

9. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims, characterised by the feature that for supporting the frame with respect to the axle piece or for damping or limiting the oscillating motion of the frame springs, rubber buffers or elastic stops are provided.

10. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims, characterised by the feature that the axle piece is substantially in the form of a transverse beam, at the ends of which the guiding elements supporting the wheels, for instance two superposed link members, are pivotally mounted and against which the springs for springing the wheels bear.

11. Suspension means for connecting the wheels to the frames of vehicles, more particularly as claimed in any of the preceding claims, and having an axle piece which is connected to the frame in such a manner as to be capable of swinging around a substantially central longitudinal axis of the vehicle, on which axle piece the wheels are resiliently suspended, characterised by the feature that the axle piece, which is preferably in the form of a tube, is hollow and the springing means for springing with respect to the frame and to one another the wheels which are mounted on the axle piece in such a manner as to be capable of swinging, said springing means preferably comprising helical springs, being preferably arranged within the interior of the hollow axle piece.

12. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims, characterised by the feature that both the springing of the wheels with respect to the axle piece (or with respect to one another) and the supporting of the frame with respect to the axle piece is effected by means of helical springs, more particularly unguided helical springs.

13. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims, characterised by the feature that the springs for springing the frame with respect to the axle piece are harder than the springs for supporting the wheels with respect to the axle piece.

14. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims,

characterised by the feature that the central axes of the damping buffers between the frame and the axle piece are disposed substantially tangentially with respect to the radii radiating from the longitudinal axis of oscillation, for instance such that the rubber buffer in the form of a cylindrical body disposed between two stops of the axle piece is disposed within a bore provided on the frame, which has a central axis extending tangentially to the said radii, and is connected to the wall of the bore, for instance by vulcanization.

15. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims, characterised by the feature that on either side of the central longitudinal plane of the vehicle the axle piece is disposed between two rubber buffers which bear from the front and the back against the axle piece and partially embrace the same.

16. Suspension means for connecting the wheels to the frames of vehicles as claimed in any of the preceding claims, characterised by the feature that the axle piece is connected to a curved member having substantially the form of the arc of a circle, on which the frame can roll by means of a corresponding rolling member, such that the centre of oscillation of the frame is placed as high as possible with respect to the axle piece, for instance at the same height as or above the centre of gravity of the vehicle body.

17. The improved suspension means for connecting the wheels to the frames of vehicles, substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 24th day of January, 1935.

MARKS & CLERK.

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Fig. 1.

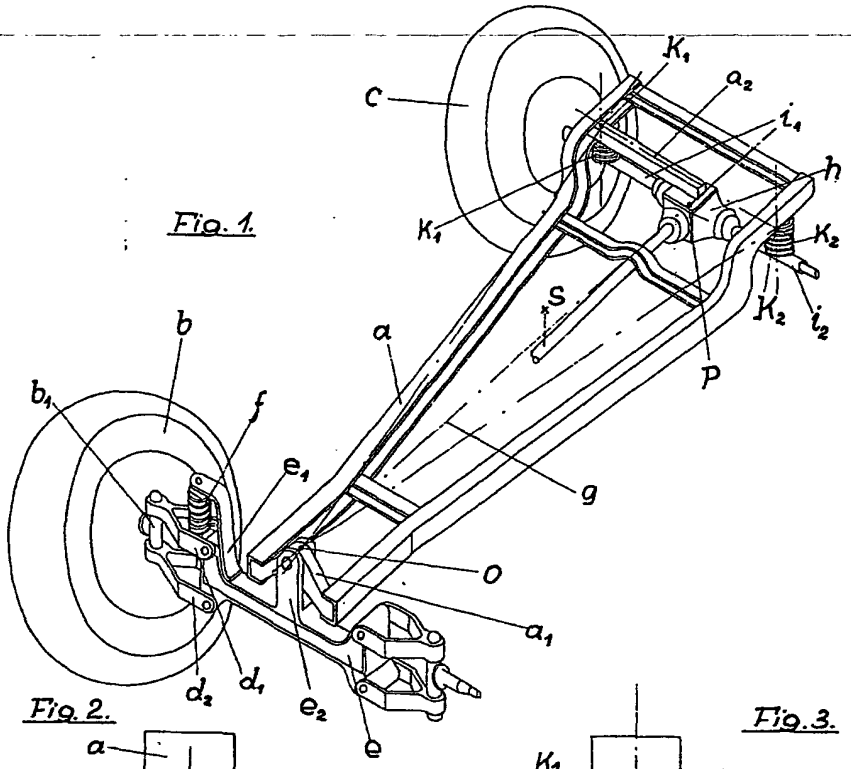

Fig. 2.

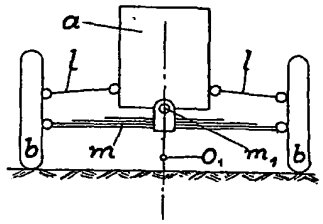

Fig. 3.

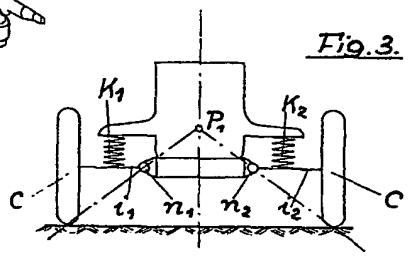

Fig. 4.

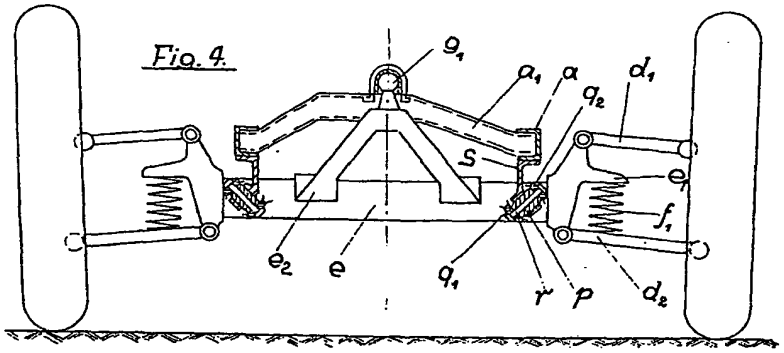

Fig. 5.

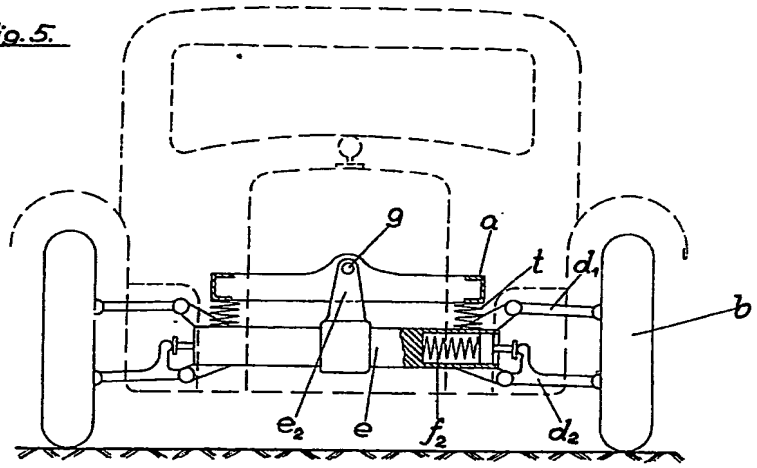

Fig. 6.

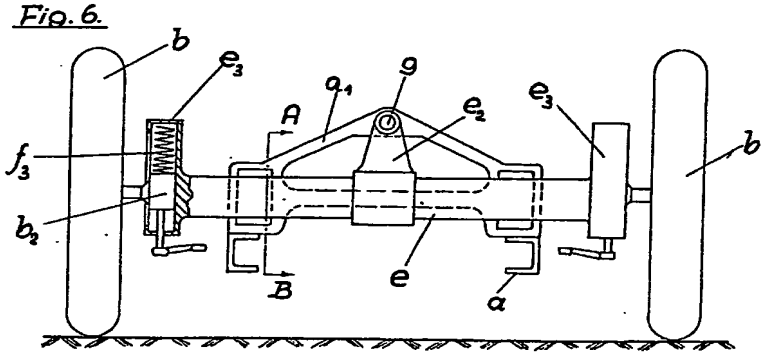

Fig. 7.

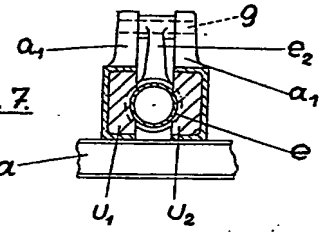

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Fig. 1.

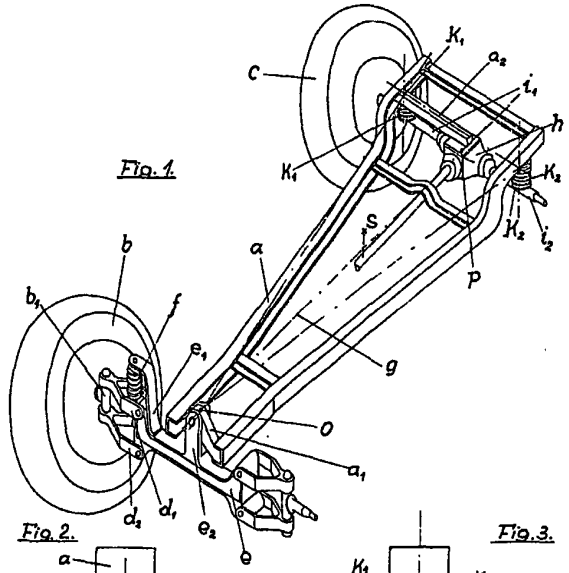


Fig. 2.

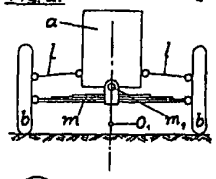


Fig. 3.

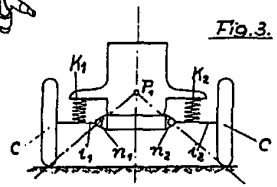


Fig. 4.

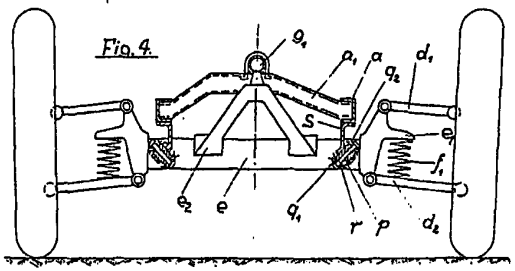


Fig. 5.

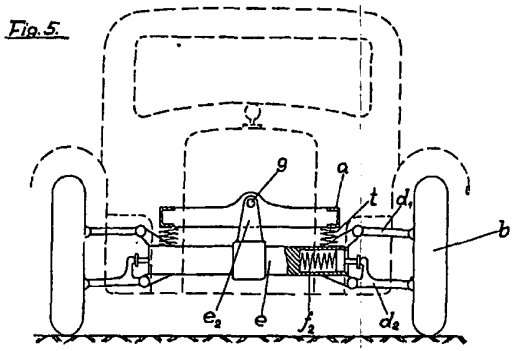


Fig. 6.

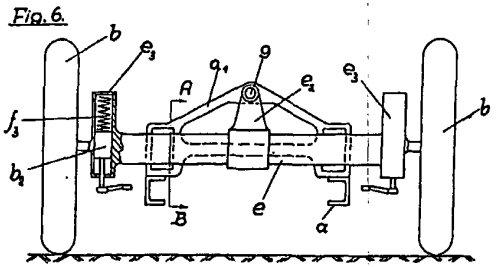
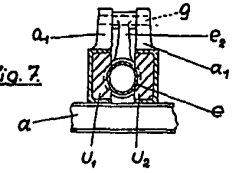


Fig. 7.



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